FLINN SCIENTIFIC

Name_____

Refraction and Total Internal Reflection Worksheet

Data Table

Part 1. From Air into Gelatin

Incident Ray	Angle of Incidence (θ_1)	Angle of refraction (θ_2)	Index of Refraction of Gelatin (n_2)	Average index of Refraction of Gelatin
A	10°	°		
B	20°	°		
C	30°	°		
D	40°	°		
E	50°	°		
F	60°	°		
G	70°	°		

Analysis and Calculations

Part 1

1. Look at the diagram Air into Gelatin. Is each refracted ray closer to the 0° line or farther away from the 0° line compared to its corresponding incident ray?

2. Using Equation 2 and the data from the table, calculate the index of refraction "n_2" for each ray. The index of refraction of air is needed in order to complete this calculation. See the answer to Question 2 in the *Pre-Lab Questions*. Show all work for the calculation of A. Record the index of refraction calculated for each ray A–G in the data table.

3. Calculate the average index of refraction for light in gelatin. Record this value in the data table.

4. Using the average of the index of refraction for gelatin and Equation 1 from the *Background* section, calculate the speed of light in gelatin.

5. Is the speed of light in gelatin greater or less than the speed of light in air?

6. Look at the speed of light in air and its index of refraction. Next, look at the speed of light in gelatin and its index of refraction. What is the relationship between the index of refraction and the speed of light in a substance? How does this agree with the formula $n = c/v$?

Part 2

7. Look at the diagram Gelatin into Air. Is each refracted ray closer to the 0° line or farther away from the 0° line compared to its corresponding incident ray? Explain the results.

8. According to the diagram Gelatin into Air, at what angle of incidence was total internal reflection first observed?

9. Total internal reflection occurs when the angle of incidence is greater than the critical angle. Based on your data, between what two angles of incidence does the critical angle occur for gelatin and air?

10. The critical angle of a substance is the angle of incidence (θ_1) at which the angle of refraction is 90°. This can only occur when the speed of light increases as it travels from one substance into another. Calculate the critical angle (θ_1) between gelatin and air using the formula below. Remember, in this part of the experiment gelatin is substance #1, therefore n_1 is the index of refraction for gelatin (average calculated in Part 1) and n_2 is the index of refraction of air (calculated in the *Pre-Lab Questions*).

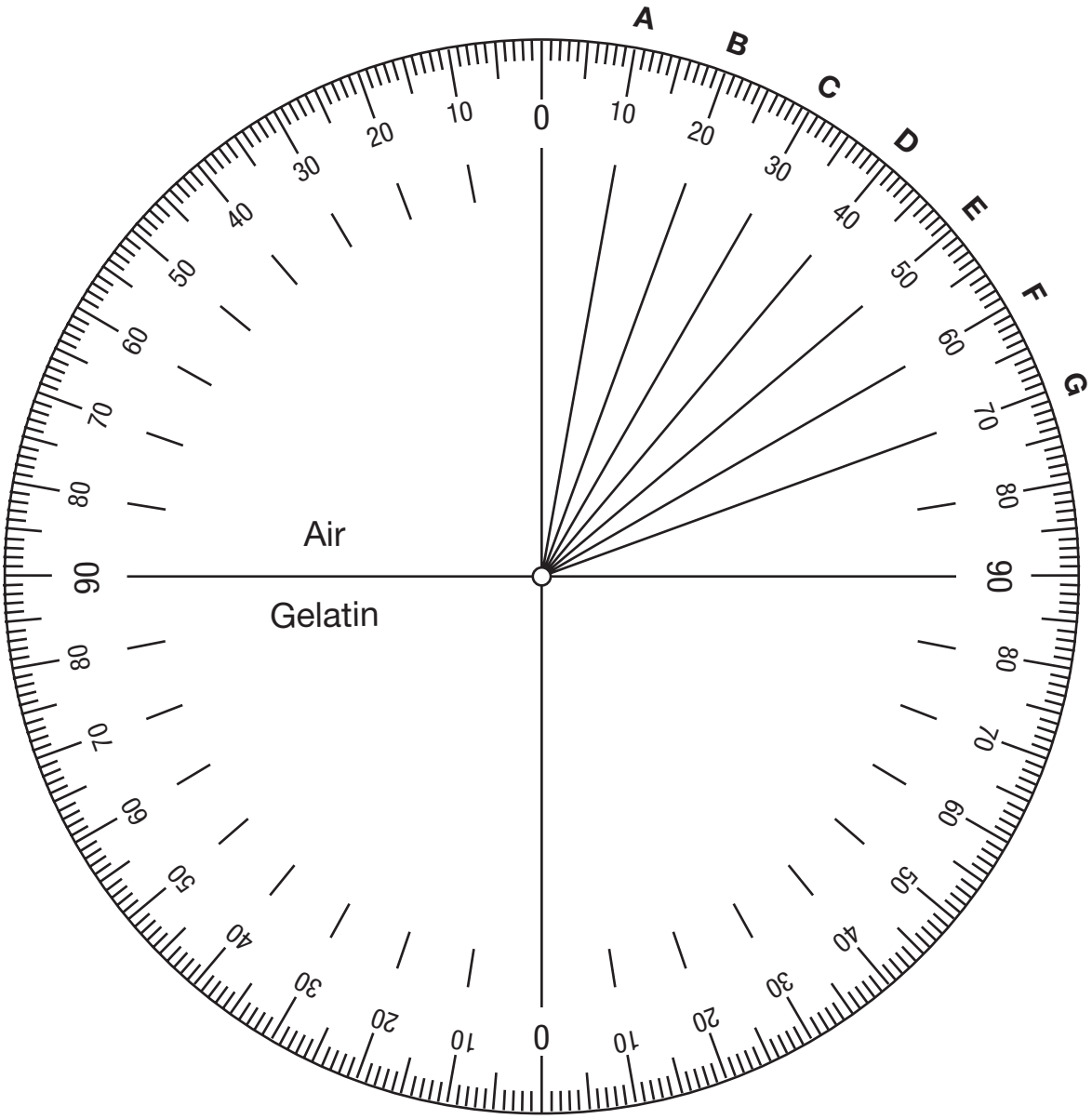
$$n_1 \sin \theta_1 = n_2 \sin 90°$$

11. Does the critical angle calculated above agree with the results on the diagram Gelatin into Air? Explain.

12. Look at both diagrams—Air into Gelatin and Gelatin into Air. In what diagram is the speed of light increasing as it enters substance #2? In what diagram is the speed of light decreasing as it enters substance #2? Explain.

13. What relationship can be made between the direction of the refracted ray of light (closer to, or away from the 0° line), and the increase or decrease in the speed of light?

Air into Gelatin



Gelatin into Air